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# MANGROVE LITTER PRODUCTION AND SEASONALITY OF DOMINANT SPECIES IN ZANZIBAR, TANZANIA

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## ABSTRACT

This study is aimed at examining the litter production and seasonality of *Avicennia marina*, *Bruguiera gymnorhiza*, and *Rhizophora mucronata*. Litter was collected using nylon litter traps of 1 $mm^2$ mesh size in the Uzi-Nyeke mixed mangroves, Zanzibar, over a period of 2 years. Contents were sorted, dried, weighed, and the average daily litter production for each component was calculated. A distinct seasonality and species variation were found in all mangrove litter components. The average annual litterfall rate was higher in *B. gymnorhiza*, followed by *R. mucronata* and *A. marina* (3.0, 2.8, and 2.0 ton dry wt. $ha^{-1}$ $year^{-1}$ respectively). Leaf fraction was the main component of litter in all species, but fruit and flower for *R. mucronata* also had a considerable contribution to the total litterfall. The presented patterns of litter production are associated with average temperature and wind speed which are both strongly correlated with litter seasonality. Our data contributes to the body of knowledge on patterns of litter production and the ecological integrity of mangrove forests in Zanzibar.

**Keywords:** Litterfall, mangrove species, seasonal patterns

## INTRODUCTION

Mangroves are amongst the most productive ecosystems in terms of gross primary productivity and litter production (Bouillon *et al.,* 2008; Coronado-Molina *et al.,* 2012; Wang'ondu *et al.,* 2014). Mangrove litter is a continuous accumulation of fallen vegetative and reproductive parts of the plants. It forms the upper most layer of the forest floor. Litter produced by mangrove forests forms a primary source of organic matter available as a source of food to a wide variety of marine invertebrate and detritus feeding organisms, which inhabit the mangrove forests, the intertidal mudflats and near shore waters (Lee, 1995; Betoulle *et al.,* 2001; Bouillon *et al.,* 2008). Mangrove litter is mineralized within the forest. Here, nutrients are either retained in the system to support further production, or are exported by the tide to nearby coastal waters (Alongi, 1998). It is therefore one of the most important sources of carbon and nutrients in the biogeochemical cycle of estuarine food webs (Wafar *et al.,* 1997).

Mangrove litterfall usually exhibits seasonal variation influenced by several factors including geographical location, rainfall, temperature, solar radiation, high winds, storms, nutrient concentrations, types of forest substrate, and freshwater drainage (Cox & Allen, 1999; Twilley & Day, 1999). The seasonal patterns of litterfall show unimodal, bimodal or irregular modes within several ecosystem types and even for different tree species in the same ecosystems (Clough *et al.,* 2000; Scheer *et al.,* 2009; Zhang *et al.,* 2014). For example, in a sub-tropical mangrove forest, the highest mean annual litterfall production occurs during autumn and slows down during the winter season (Mfilinge *et al.,* 2005). In a tropical mangrove forest, litter production occurred throughout the year**,** with peaks influenced by both the rainy and dry seasons (Wang'ondu *et al.,* 2014). In temperate mangrove systems, litterfall was reported to be bimodal with the highest production during the summer season (Duke, 1990; May, 1999).

To our knowledge, only one comprehensive work on the rate of mangrove litter production has been conducted at Maruhubi and Chwaka Bay in Zanzibar in the past fifteen years. Shunula & Whittick, (1999) reported that litter production occurs throughout the year and with unmarked seasonal trends. However, changes in climate and weather recently reported in Zanzibar (Watkiss *et. al.,* 2012), had concomitant effects on the local temperature and precipitation patterns, storminess, and sea-level rise (Snedaker, 1995; Nigel, 1998). In the last fifteen years, many different conditions have evolved. This study is therefore aimed at comparing the seasonality and species variation in litter production of three dominant mangrove species in Zanzibar, namely *Avicennia marina* (Forssk.) Vierh. (Avicenniaceae), *Bruguiera gymnorhiza* (L.) Lam. (Rhizophoraceae) and *Rhizophora mucronata* Lam. (Rhizophoraceae).

**Study area**

The Zanzibar Archipelago is composed of two major islands: Unguja and Pemba in the Indian Ocean. They are 25–50 km off the east coast of the Tanzania mainland and consist of about 50 small islets surrounding the main islands. This study was conducted in Uzi-Nyeke mangrove forest on the southern part of the main Island of Unguja along the Uzi channel (6°19'–6°24'S, 39°25'E; figure 1). The area is characterized by a tropical climate with a bimodal rainfall pattern. The long rainy season (*Masika*) occurs from March to May and the short rainy season (*Vuli*) occurs from October to November. The hot season occurs during the NE monsoon period (*Kaskazi*) between December and February and a relatively cool, dry season (*Kipupwe*) occurs between June and September. The average rainfall varies between 1000 mm to 2500 mm annually while temperatures range between 17° and 40°C. During the study period (from July 2011 to June 2012), the annual mean air temperature was 27.3°C and the total rainfall was 1398 mm (table 1). The tidal pattern is mainly semi-diurnal ranging from 2 m during neap tide to 4 m during spring tide and the mangrove forest is frequently inundated by tides (Mwandya *et al*., 2010).

The Uzi-Nyeke contains the most extensive mangrove forest, which lies within the Menai Bay Conservation Area. The forest comprises mixed stands mangrove species, which belong to six families, with eight species reported to occur in the area (table 2). The mangroves of Uzi-Nyeke form a distinct zonation which can be divided into the upper zones (closest to the land), lower zone (closest to the open sea) and mid-zone (between the upper and lower zones).

*Table 1. Monthly mean values for climatic parameters in the study area from July 2011 to June 2012.*

| | | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Marc | Apr | May | June |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp (°c) | Max | 29.8 | 29.9 | 31.6 | 31.1 | 30.6 | 32.4 | 33 | 33.2 | 32.1 | 30.9 | 29.7 | 29.5 |
| | Min | 22.7 | 21.8 | 22.5 | 22.8 | 23.5 | 24.5 | 25 | 24.2 | 24.3 | 24.7 | 23 | 22.9 |
| % Relative humidity | | 76 | 77 | 79 | 81 | 87 | 85 | 77 | 76 | 82 | 83 | 86 | 81 |
| Total Rainfall (mm) | | 0.7 | 30.2 | 147.4 | 218 | 393 | 92.1 | 22.3 | 29 | 150.5 | 178.4 | 121 | 15.2 |
| Wind (Knt) | 9.00 am | 9 | 8 | 9 | 8 | 10 | 8 | 13 | 11 | 7 | 9 | 7 | 8 |
| | 3.00 pm | 14 | 15 | 14 | 11 | 11 | 9 | 14 | 11 | 7 | 11 | 12 | 12 |

Source: Tanzania Meteorological Agency-Zanzibar (2011-2012)

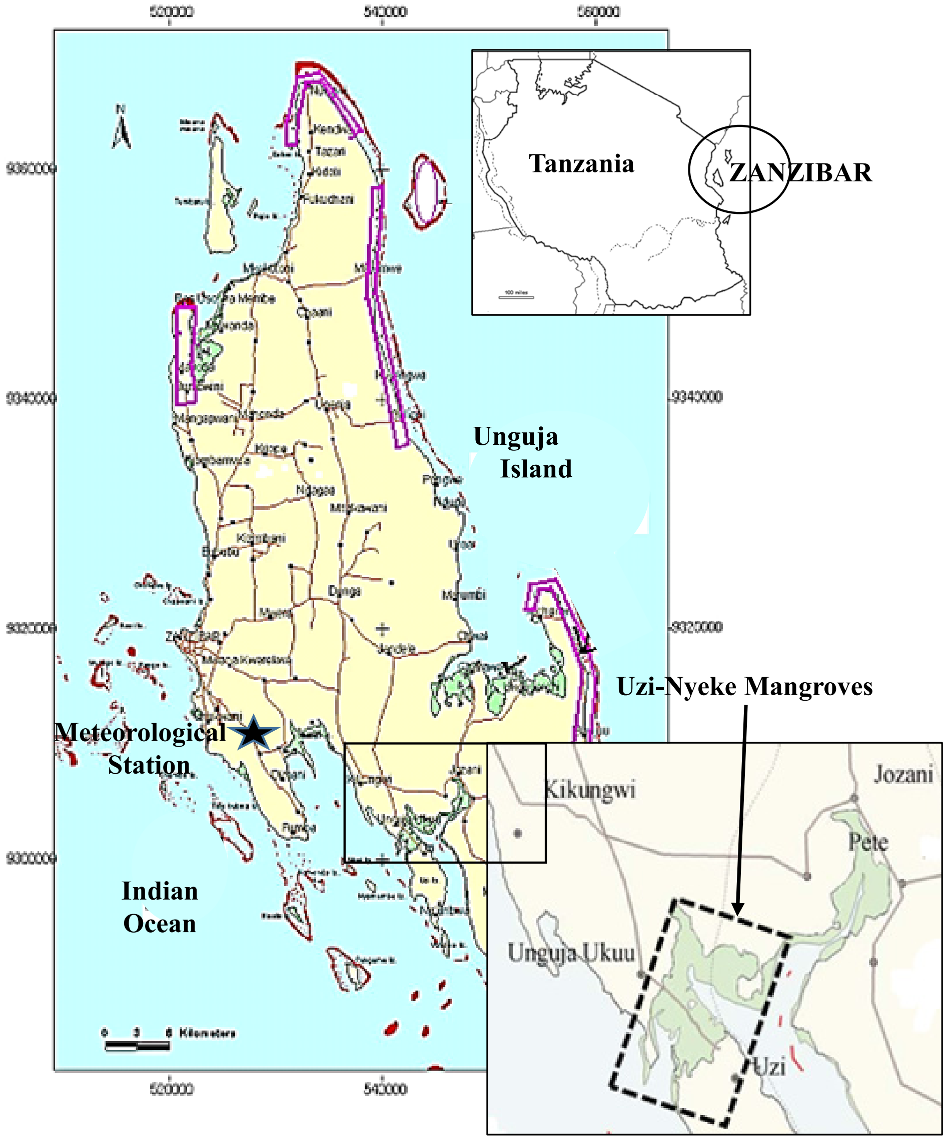


*Figure 1. Map of the Zanzibar, showing Unguja Island and the position of the study site.*

## MATERIALS AND METHODS

### Litter collection

Litterfall was collected in 0.25 $m^2$ nylon litter traps of 1 $mm^2$ mesh size (Mfilinge *et al.*, 2005). A total of 10 litter traps per species were fixed randomly and secured under mangrove trees. Each trap was secured in such a way that it remained vertically upright and was suspended above the maximum tidal water level (1.5 m) and at a position which ensured the

*Table 2. Mangrove species of Zanzibar Island*

| Family name | Scientific name | Local name |
|---|---|---|
| 1. Avicenniaceae | *Avicennia marina* (Forssk.) Vierh. | Mchu |
| 2. Rhizophoraceae | *Bruguiera gymnorhiza* (L.) Lam. | Msisi/Msinzi/Mfinzi or muia |
| 3. Rhizophoraceae | *Ceriops tagal* (Perr.) C.B.Rob. | Mkandaa/Mkoko mwekundu |
| 4. Combretaceae | *Lumnitzera racemosa* Willd. | Kikandaa or mkandaa dume/ Kilalamba |
| 5. Rhizophoraceae | *Rhizophora mucronata* Lam. | Mkoko magondi |
| 6. Sonneratiaceae | *Sonneratia alba* Sm. | Mlilana or Mpira |
| 7. Meliaceae | *Xylocarpus granatum* J.König | Mkomafi/Mkaumwa/Mkuo/ Mtonga |
| 8. Lythraceae | *Pemphis acidula* J.R.Forst. & G.Forst. | Kilalamba dume |

Source: Mchenga & Rashid (2011)

maximum catch of litter. Tree canopy height of the dominant species was *A. marina*, 8–10 m; *B. gymnorhiza,* 7–9 m; and *R. mucronata,* 6–12 m. Litter was collected monthly from July 2011 to June 2012. Litter contents were sorted into the components of leaves, twigs, fruits, and flowers. Each component was dried at 80°°C over a 48 h period to a constant dry weight. The total litter weights of each component for each species were then calculated into average daily litter production. The data on climatic variables were obtained from the Zanzibar station of Tanzania Meteorological Agency, located at Karume International Airport about 5 km away from the study area.

**Statistical analysis**

Mean values and standard error were calculated. The difference in total litter production among the 12 sampling months and four seasons and their interaction were tested using a multivariate analysis of variance (Two-way ANOVA). The effects of season (four-levels) and mangrove species (three-levels) were entered as fixed factors, with the total litter components of leaf, twig, flower, and fruit used as dependent variables. Any significant seasonal or monthly effects were further examined using the post-hoc Fisher's least significant difference (LSD) test. Paired t-tests were used to evaluate differences in total litter production of various litter components between mangrove species. The linear relationships between the monthly litter production of leaves, fruits, twigs, and flowers of each mangrove species and monthly climatic parameters (temperature, rainfall, humidity, and wind speed) were calculated using Pearson correlations. For all tests, a criterion of $p < 0.05$ was used to determine statistical significance. All statistical analysis was performed using the SPSS 10 for Windows (SPSS, Chicago, Illinois, USA).

## RESULTS

**Litter production and composition**

Litter production of leaves, twigs, fruits, and flowers for different mangrove species are presented in figure 2a–d. The total litter production significantly differed between mangrove species with the lowest contribution for *A. marina* when compared to *B. gymnorhiza* and

*R. mucronata* (ANOVA, F=16.969, $p<0.0001$, table 3. The average annual production was estimated to be 2.0±0.5 ton dry wt. $ha^{-1}$ $yr^{-1}$ for *A. marina*, 3.0±0.7 ton dry wt..$ha^{-1}$.$yr^{-1}$ for *B. gymnorhiza*, and 2.8±0.7 ton dry wt.$ha^{-1}$.$yr^{-1}$ for *R. mucronata*. The total litter contribution of the three dominant mangrove species in the study area was 7.8±1.9 ton dry wt.$ha^{-1}$.$yr^{-1}$.

Leaf litter was the major contributor to total litter production (65–76%), followed by fruit litter (5–16%) and flower litter (7–14%). The least was twig litter (4–12%). The litter components varied significantly within and among mangrove species ($p<0.0001$). Leaf litter was significantly higher for *B. gymnorhiza* when compared to *A. marina*, but did not differ with *R. mucronata*. There was also no difference in leaf litter production between *A. marina* and *R. mucronata*. Twig litter showed no significant difference between mangrove species. Fruit litter production varied significantly among the presented mangrove species. There was a significantly higher flower litter production in *R. mucronata* compared to *B. gymnorhiza* and *A. marina* (table 3).

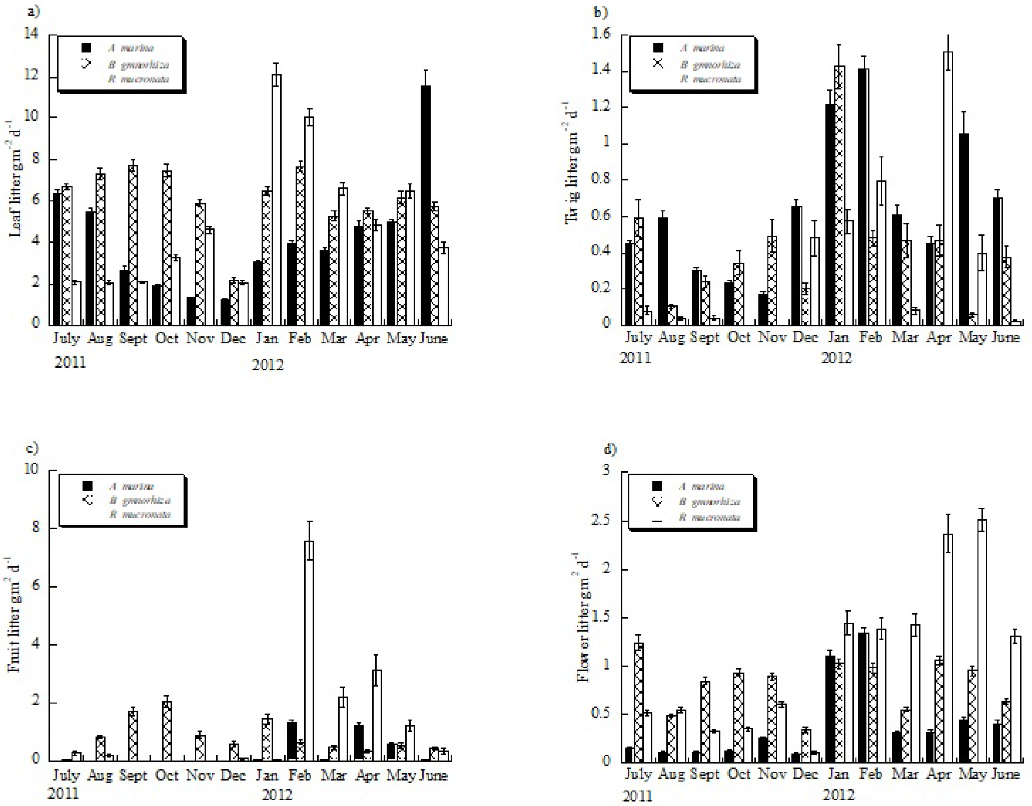


*Figure 2 a-d. Comparison in litter productions in three mangrove species.*

**Seasonality of litter production**

Litter production in the study area varied significantly between the four seasons. The interaction effects of species and season on mangrove litter production was observed during the study period (ANOVA, F=15.193, p<0.0001, table 4). *Avicennia marina* leaf litter increased significantly from January and reached peak production in June (11.6±0.7 $g.m^2.d^{-1}$), while *B. gymnorhiza* leaf litter was nearly the same throughout the year with the lowest value recorded in December (2.2±0.1 $g.m^2.d^{-1}$). *Rhizophora mucronata* recorded a higher production of leaf litter in January (12.1±0.6 $g.m^2.d^{-1}$; figure 2a). The amount of twig litter was higher in January and February for both *A. marina* and *B. gymnorhiza* (1.4±0.1 $g.m^2.d^{-1}$ and 1.4±0.2 $g.m^2.d^{-1}$ respectively), while *R. mucronata* recorded the highest value in April (1.5±0.3 $g.m^2.d^{-1}$; figure 2b). A considerable amount of fruit litter for *B. gymnorhiza* was collected between August and February with a maximum value of 2.0±0.2 $g.m^2.d^{-1}$ in October, while peak fruit production for both *A. marina* and *R. mucronata* was observed in February (1.3±0.1 $g.m^2.d^{-1}$ and 7.6±0.6 $g.m^2.d^{-1}$ respectively; figure 2c). The flowering patterns recorded the highest flower litter rate of 1.3±0.1 $g.m^2.d^{-1}$ for *A. marina* in February, 1.2±0.1 $g.m^2.d^{-1}$ for *B. gymnorhiza* in July, and 2.5±0.1 $g.m^2.d^{-1}$ for *R. mucronata* in April (figure 2d).

*Table 3. Litter fall rate of three dominant species of Uzi-Nyeke mangrove forest. Same superscript indicates no significant difference at 5% significance level. Values are mean and SE.*

| Litter components ($g.m^2.d^{-1}$) | *A. marina* | % | *B. gymnorhiza* | % | *R. mucronata* | % |
|---|---|---|---|---|---|---|
| Leaf | $0.42±0.01^{a}$ | 76 | $0.62±0.02^{b***}$ | 75 | $0.50±0.02^{a,b}$ | 65 |
| Twig | $0.07±0.00^{a}$ | 12 | $0.04±0.00^{a}$ | 5 | $0.03±0.00^{a}$ | 5 |
| Fruit | $0.03±0.00^{a}$ | 5 | $0.08±0.00^{b**}$ | 10 | $0.13±0.01^{c***}$ | 16 |
| Flower | $0.04±0.00^{a}$ | 7 | $0.08±0.00^{b***}$ | 10 | $0.11±0.00^{c***}$ | 14 |
| Total/ Day | $0.56±0.03^{a}$ | 100 | $0.83±0.04^{a}$ | 100 | $0.77±0.05^{a}$ | 100 |
| Total/Year.($t.ha^{-1}.yr^{-1}$) | $2.0±0.1^{a***}$ | | $3.0±0.15^{b}$ | | $2.8±0.19^{b}$ | |

*$p$ <0.05; **$p$ <0.01; ***$p$ <0.001.

The litter peaks for mangrove species were strongly influenced by dry, hot, and/or rainy seasons (table 5). Over 51% of *A. marina* total leaf litter and 37% of *B. gymnorhiza* were collected during "*Kipupwe*", the cool dry season between June and September. In contrast, *R. mucronata* maximum leaf litter collections (40%) were recorded during hot season "*Kaskazi*", in January and February. There was a significant interaction effect for species and seasons, with significant differences between seasons for leaf litter production (ANOVA, F=21.318, p<0.0001 and F=17.810, p<0.0001 respectively). Regardless of mangrove species, twig litter collection was over 40% during the hot season in January and February, however *R. mucronata* recorded the maximum twig litter collection (49%) during the peak of the long rainy season, particularly during April. Although there was a significant difference in twig litter production between the long rainy season and hot or dry seasons (ANOVA, F=5.284, p<0.01, pair wise comparison, p<0.001), no significant interaction effect was found for species and seasons. *B. gymnorhiza* showed fruit litter production in almost all months with no significant seasonal differences, but with maximum collection during "*Kipupwe*", the dry season (30%). In contrast, fruit litter collection ranged from 41 to 56% during the hot and long rainy season for both *A. marina* and *R. mucronata*. There was a significant interaction effect for species and seasons, with significant differences between seasons for fruit litter production (ANOVA, F=4.017, p<0.001 and F=6.197, p<0.0001

*Table 4. Two-way ANOVA results for the effects of species and season on mangroves production (F-values, NS = not significant, *P <0 .05, **P<0 .01, ***P<0 .001).*

| Variables | Leaf litter | | | Twig litter | | | Fruit litter | | | Flower litter | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | df | MS | F | df | MS | F | df | MS | F | df | MS | F |
| Factors | | | | | | | | | | | | |
| Species | 2 | 8161 | 22.478*** | 2 | 64.1 | 0.925NS | 2 | 1562 | 5.447** | 2 | 536.34 | 18.695** |
| Season | 3 | 6466 | 17.81*** | 3 | 366 | 5.284** | 3 | 1777 | 6.197*** | 3 | 664.9 | 23.177*** |
| Species* seasons | 6 | 7739 | 21.318*** | 6 | 88.6 | 1.279NS | 6 | 1152 | 4.017*** | 6 | 366.82 | 12.786*** |
| Error(s) | 228 | | | 228 | | | 228 | | | 228 | | |

*Table 5. Seasonality of litter production for three mangrove species (AM=* A. marina*, BG=* B. gymnorhiza *and RM=* R. mucronata*).*

| Components | %Leaf litter | | | %Twig litter | | | %Fruit litter | | | %Flower litter | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | AM | BG | RM | AM | BG | RM | AM | BG | RM | AM | BG | RM |
| Seasons | | | | | | | | | | | | |
| Hot | 16.1 | 22.1 | 40.3 | 41.8 | 40.1 | 45.9 | 41.9 | 26.9 | 51.2 | 52.9 | 23.6 | 22.8 |
| Long rain | 26.3 | 22.9 | 29.9 | 27.0 | 18.8 | 49.5 | 56.1 | 13.6 | 43.3 | 22.6 | 25.7 | 48.8 |
| Cool dry | 51.2 | 37.0 | 16.6 | 26.0 | 25.1 | 4.6 | 2.0 | 30.1 | 5.5 | 16.4 | 32.3 | 21.0 |
| Short rain | 6.4 | 18.0 | 13.2 | 5.2 | 16.0 | 0.0 | 0.0 | 29.4 | 0.0 | 8.1 | 18.4 | 7.4 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

respectively). Similar patterns were found in flower litter production for both *A. marina* and *R. mucronata* where peak collection occurred during the hot and long rainy season (between 23–53%). About 26% and 32% of *B. gymnorhiza* total flower litter collection occurred during long rain and dry seasons respectively. There was a significant interaction effect for species and seasons, with significant differences between seasons for flower litter production (ANOVA, $F=12.786$, $p<0.0001$ and $F=23.177$, $p<0.0001$ respectively).

Multiple regression results showed that average temperature, rainfall, and winds were significantly correlated with mangrove litter seasonality over the period of study as shown in table 6. The seasonal patterns for leaf and twig litter production were mostly related to high temperature (average of 32.8°C) during the hot season (December to February), and high wind speed (average of 14.4 knots) during the dry season (July to September). Only the *A. marina* flower litter production was related to temperature and winds, while twig litter specifically correlated with rainfall. There was no significant correlation in fruit litter production with climatic parameters among mangrove species (table 6).

## DISCUSSION

Annual litterfall is of particular relevance for ecological restoration because it is an important indicator of mangrove productivity (Clough, 1992). The presented annual values of litterfall, between 2 to 3 ton dry wt. $ha^{-1}$ $yr^{-1}$ observed in this study, are in line with previous work on litterfall values in Zanzibar and other nearby mangrove forests of East Africa. For instance, the annual litterfall rate for *A. marina* at Uzi-Nyeke forests is consistent with the litter production values reported for *A. marina* in the nearby country of Kenya (Ochieng & Erftemeijer, 2002). However, our values are lower than those reported at Chwaka and Maruhubi mangrove stands in Zanzibar (Shunula & Whittick 1999). Variations in the amount and composition of litterfall have been found elsewhere within and between adjacent mangrove sites and with different shore heights (May, 1999; Imgraben & Dittmann, 2008). This could be due to variations in different environmental conditions such as temperature, rainfall, evaporation, and wind speed which influence the litter production rate (Juman, 2005; Zafar *et al.,* 2012).

The composition of litter was primarily composed of leaves which accounted for 65–75% of total litter production in our study site. This is consistent with previous studies (see for examples, Wafar *et al.* 1997; Clough *et al.,* 2000; Sánchez-Andrés *et al.,* 2010). The higher contribution of leaf litter is probably related to local climatic influence. In particular, winds and temperature strongly correlated with leaf litter production for all three presented species in this study. Similarly, leaf litter production of *Kandelia obovate* Sheue, H.Y.Liu & J.W.H.Yong showed a significant correlation with temperature in China. This emphasizes the important effects of climatic parameters on the seasonality of mangrove litter production (Ye *et al.,* 2013). Several studies have reported a substantial contribution of twig, fruit, and flower litter to total litter production (Hegazy, 1998; Shunula & Whittick, 1999; Chen *et al.,* 2009). In this study, *R. mucronata* contributes a considerable amount of fruit and flower litter (16 and 14% respectively) to total litter production, while *B. gymnorhiza* and *A. marina* contributions ranged between 4 and 10% respectively. Differences in litter production of the reproductive materials (bud, flower and fruit/propagule) were reported in Zanzibar for *B. gymnorhiza* and *S. alba* (Shunula & Whittick, 1999), and in Gazi Bay, Mombasa, Kenya for *R. mucronata* and *S. alba* (Wang'ondu *et al.,* 2014) and for *Rhizophora apiculata* Blume in Vietnam (Nga *et al.*, 2005).

*Table 6. Pearson correlation valuse and their significance (*P <0 .05, **P <0 .01 (2-tailed). Species abbreviation as in Table 5.*

| Components | Leaf litter | | | Twig litter | | | Fruit litter | | | Flower litter | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | AM | BG | RM | AM | BG | RM | AM | BG | RM | AM | BG | RM |
| Temp (°C) | -0.59* | -0.12 | 0.65* | 0.43 | 0.47 | 0.67* | 0.22 | 0.31 | 0.44 | 0.58* | -0.07 | -0.09 |
| RH (%) | -0.26 | -0.59* | -0.19 | -0.32 | -0.37 | 0.04 | -0.04 | -0.10 | -0.23 | -0.38 | -0.26 | 0.20 |
| Rainfall (mm) | -0.55 | -0.08 | -0.16 | -0.61* | -0.17 | -0.09 | -0.08 | 0.29 | -0.17 | -0.34 | 0.05 | -0.08 |
| Wind (knt) | -0.22 | 0.59* | 0.65* | 0.40 | 0.82** | 0.31 | 0.19 | 0.25 | 0.22 | 0.71** | 0.47 | 0.00 |

Mangrove litter production is a continuous process, but has considerable seasonality (Wafar *et al.,* 1997; Clough *et al.,* 2000). Many studies have reported significant seasonality of litter production in tropical and/or sub-tropical mangrove forests (Shunula & Whittick, 1999; Ochieng & Erftemeijer, 2002; Mfilinge *et al.,* 2005). In the present study, the highest leaf litter production for *A. marina* and *B. gymnorhiza* were recorded during the cool dry season "*Kipupwe*" (June to September) which is characterised by strong wind speed. This finding is consistent with Shunula and Whittick's (1999) study for *A. marina* conducted at Maruhubi, Zanzibar and a study by Slim *et al.* (1996) conducted in Gazi Bay, Mombasa, Kenya. In Japan, peak litter production in *B. gymnorhiza* was reported in autumn and was attributed to the strong winds of typhoon storms (Mfilinge *et al.,* 2005). *R. mucronata* maximum leaf litters collections (40%) occurred in January and February during the hot season "*Kaskazi*" which was influenced by high temperature (33°C on average). It is known that high temperatures can speed up the rate of transpiration and increase the salt content of mangrove leaves which leads to senescence and consequently to increased litterfall (Twilley *et al.,* 1986; Shunula & Whittick, 1999).

Our findings of twig litter production did not differ between mangrove species; however, they demonstrated seasonal variations with maximum collections during the hot season in January and February when temperature is high. This is supported by a strong correlation of twig litter production with temperature; in particular, for *R. mucronata*. Although both flower and fruit litter production occurred throughout the year, each presented species show significant seasonality. *A. marina* flowering peaks occurred in February whereas *B. gymnorhiza* had peaks in July and *R. mucronata* in April. This is contrary to the findings reported by Shunula and Whittick (1999) where *B. gymnorhiza* and *Ceriops tagal* showed no significant seasonal differences in leaf, flower, or fruit production, *A. marina* however, showed strong seasonality where flowering reach peaks in November and December.

In conclusion, litter productions of Uzi-Nyeke mangrove forests of the Menai Bay Conservation area have lower values of annual litter productions compared to those reported earlier by Shunula and Whittick (1999) at Maruhubi and Chawka Bay Mangrove forest in Zanzibar. This study found a strong correlation with temperature and wind speed with various mangrove litter components, hence the driving force regulating and greatly influencing the seasonality of litter production in this study area. The leaf litter production shows strong seasonality for *A. marina* and *B. gymnorhiza* with maximum values recorded during cool dry season "*Kipupwe*" (June to September) and for *R. mucronata* during hot seasons "*Kaskazi*" (January–February). Apart from the main component of leaf fraction, litter production of the reproductive parts (flower and fruits/propagules) also has considerable contribution to the total litterfall, such as for *B. gymnorhiza* and especially *R. mucronata* fruits/propagules. Although overall reproductive parts marked significant seasonality they are species-specific. These results update the available data of the litter production patterns of three mangroves species in Zanzibar and also inform management and conservation strategies of the Uzi-Nyeke mangrove forest in the Menai Bay Conservation Area and other similar tropical areas, particularly when the choice species and availability of planting materials are considered.

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